Question: What is the molar concentration of SO_4^{2-} anions in the solution consisting of 38.4 g of $Cr(NO_3)_2$ and 60.8 g of $CuSO_4$ which has been dissolved in sufficient water to make 245 mL of solution?

Solution:

The salts proposed in the task are salts of strong acids and weak bases, therefore hydrolysis takes place over the cation (Cr/Cu). And there is no effect on the amount of sulfate ions. When a salt dissolves in water, it dissociates to form ions (two stages):

I. $Cu^{2+} + SO_4^{2-} + HOH \Leftrightarrow CuOH^+ + SO_4^{2-} + HOH$
$CuSO_4 + HOH \Leftrightarrow [Cu(OH)]_2SO_4 + H_2SO_4$

II. $[Cu(OH)]_2SO_4 \Leftrightarrow 2CuOH^+ + SO_4^{2-}$
$CuOH^- + SO_4^{2-} + HOH \Leftrightarrow Cu(OH)_2 + SO_4^{2-} + HOH$
$[Cu(OH)]_2SO_4 + HOH \Leftrightarrow Cu(OH)_2 + H_2SO_4$

$CuSO_4 = Cu^{2+} + SO_4^{2-}$

$CuSO_4$ (solid) + HOH (liquid)--> Cu^{2+} (aq) + SO_4^{2-}(aq) + HOH (liquid), where are s=solid, l=liquid, aq=aqueous solution in water. Amount (n) of SO_4^{2-} = n $CuSO_4$. For solids, amount of substance (n) = m (mass of substance)/M (molar mass of substance), i.e. n $CuSO_4$ = m $CuSO_4$/M $CuSO_4$ = 60.8 g/160 g/mol=0.38 mol. Then n SO_4^{2-} = n $CuSO_4$ = 0.38 mol. Molar concentration of SO_4^{2-} = n SO_4^{2-} / V solution = 0.38 mol /245 ml = 0.00155 mol/ml or 1.551 mol/l

Answer: **0.00155** mol/ml or **1.551** mol/L of SO_4^{2-} anions